

DAY ONE PROJECT

Re-envisioning Reporting of Scientific Methods

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Summary

The information contained in the methods section of the overwhelming majority of research publications is insufficient to definitively evaluate research practices, let alone reproduce the work. Publication—and subsequent reuse—of detailed scientific methodologies can save researchers time and money, and can accelerate the pace of research overall. However, there is no existing mechanism for collective action to improve reporting of scientific methods. The Biden-Harris Administration should direct research-funding agencies to support development of new standards for reporting scientific methods. These standards would (1) address ongoing challenges in scientific reproducibility, and (2) benefit our nation’s scientific enterprise by improving research quality, reliability, and efficiency.

Challenge and Opportunity

Transparency around research methodologies is essential for driving public trust in science and for ensuring accurate, replicable research results. Yet most research publications only contain an abridged version of the methodologies used to obtain the results therein: the “teaser trailer,” so to speak, rather than the whole movie. Insufficient methodological detail makes it impossible to definitively evaluate research practices, let alone reproduce the work. In addition to undermining confidence in research results, this reality leads to enormous inefficiencies in our nation’s scientific enterprise. When methods developed by one laboratory cannot be easily adapted and used by others, individual laboratories must painstakingly and repeatedly reinvent the same scientific protocols.

Poor methods reporting can be attributed to two factors. First, article length limits encourage authors to truncate methods sections in order to save space for reporting results and conclusions. These limits were understandable in the past, when publishers working in a print-dominant world needed to manage the number of pages in physical journal issues. But in today’s digital era—when supporting information can easily be made available in files accompanying the main text of an article—there is no practical reason to omit methodological detail. Second, the quality of a research publication is typically evaluated on the strength of its results and conclusions rather than on the quality of its methods. Researchers therefore have little incentive to prepare detailed methods sections even if length is not a constraining factor. Given the societal benefits that transparent and reproducible scientific methods can deliver, smart public policy is needed to mandate and/or motivate better methods reporting.

Some publishers have made efforts to strengthen disclosure of methods and protocols behind scientific conclusions,¹ including by launching methods-focused publications. But these practices

¹ For example, Materials Data Analysis Reporting (MDAR) checklists, protocols.io, the STAR Methods initiative of Cell Press, the reproducible article initiative of *eLife*, and the providers of laboratory notebook software such as SciNote.

are not widespread and resulting improvements have been incremental at best. Moreover, these are largely siloed efforts that would benefit greatly from shared resources and collective action.

Plan of Action

Improving methods reporting requires policies that create incentives for researchers and publishers. For researchers, recognition of detailed experimental methodologies as valuable and indispensable research outputs will increase individual and institutional investment into methods reporting. For publishers, this recognition will create potential business opportunities for new services that could be offered to the research community.

A useful first step would be for federal research-funding agencies to work with the research community and publishers to develop clear and consistent national standards for methods reporting. Common standards are already proving invaluable for the recognition and reuse of open data. The same principles could be applied to open methods. For instance, standards could require researchers to provide robust descriptions of all reagents and equipment used in an experiment, as well as step-by-step protocols that would allow someone with appropriate training to reproduce the experiment exactly as performed by the authors and/or to adapt the method to their own needs. Such standards will serve as a vital component of open science, ensuring that results are trustworthy, transparent, and replicable.

We anticipate that efforts to standardize methods reporting will face considerable challenges. Researchers may be resistant to accept reporting requirements that impose considerable time burdens. Researchers may also be concerned that detailed reporting requirements could compromise intellectual property or competitive advantage. Representatives from different disciplines will have different perspectives on what information should be made available in methods sections, and publishers may need time to adapt their business models and publishing infrastructure to accommodate new requirements.

The federal government invests tens of billions of dollars each year in research and, as such, has a significant stake in ensuring that research is reproducible and replicable. One of the most important ways that we can ensure scientific reproducibility and replicability is to ensure that when research is published, that it is accompanied by robust methods descriptions so that others can, with reasonable fidelity, reproduce the analysis and replicate the experiments. Using its convening power, the federal government can establish a forum for publishers, academics, scientific societies, and independent businesses to come together to reimagine and evolve the way we describe experimental science. Federal support for a national effort to re-envision methods reporting will also be key for limiting confusion among scientists and preempting proliferation of incompatible requirements and technologies for methods reporting. Finally, federally motivated collective action will level the playing field for publishers of all sizes. The status quo discourages publishers from implementing strong methods-reporting requirements

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out of concern that researchers will take their work to competing journals with looser requirements. Consistent national standards for methods reporting will remove this disincentive to engage in better practices.

As such, President Biden should issue a Presidential Memorandum on modernizing reporting of scientific methods. This memorandum would direct federal science-funding agencies to:

- (1) Work with publishers and representatives of the scientific community through the National Science and Technology Council to develop new standards for methods reporting.
- (2) Financially support the development of such standards.
- (3) Encourage the adoption of such standards by publishers.
- (4) Financially support establishment of new systems for archiving research protocols and methods.
- (5) Establish a robust system for crediting researchers who develop high-quality methods and protocols through the use of persistent identifiers.
- (6) Require disclosure of whether published articles are following new standards for methods reporting.

At a minimum, improved methods reporting should include detailed protocols that explain precisely what was done in the course of an experiment. Such protocols should have persistent identifiers to enable easier discovery and citation. Improved methods reporting should also include details on specific reagents and equipment used for an experiment, any deviations from existing publicly available protocols, details on how data analysis was performed, and other information that would enable someone skilled in the field to fully replicate the experiments and the results with reasonable fidelity.

The impact of modernizing methods reporting in published scientific literature cannot be overstated. Current methods reporting does not adhere to any universal standards—a fact that has led to extraordinary waste of scientific resources and has exacerbated a crisis in scientific reproducibility. Federal leadership in re-envisioning how scientific methods are reported is sorely needed and would have a transformative effect on our nation's broader scientific enterprise.

Frequently Asked Questions

Why should the federal government take an active role in driving new standards for reporting scientific methods?

There is no mechanism for collective action around standardized methods reporting in the publishing or scientific communities. Given the societal benefits that transparent and high-quality scientific methods can provide, there is a need for federal leadership to drive development of new standards for methods reporting.

Who would be responsible for adopting and ensuring compliance with new standards for methods reporting?

Compliance could be achieved through a combination of “push” incentives from publishers and “pull” incentives from funders. As is already happening for open-data standards, federal agencies can require researchers to adhere to open-methods standards in order to receive federal funding, and scientific journals can require researchers to adhere to open-methods standards in order to be eligible for publication.

Who should fund development of new standards for methods reporting?

Federal agencies invest tens of billions of dollars in research each year. Thus, they have a real interest in ensuring that the research they fund is credible and replicable, and that research investments deliver as big a return as possible. Improving how scientific methods are described is central to achieving these goals and in the best interest of the nation. Responsibility for improving methods reporting should therefore lie with government agencies.

How can the federal government encourage adoption of new standards for methods descriptions?

Federal agencies could require the deposition of detailed methods in public archives, as appropriate, for research publications resulting from federally funded scientific research. Agencies can also work with stakeholders to encourage adoption of standards through other pathways. For instance, the National Academies of Sciences, Medicine, and Engineering Board on Research Data and Information is currently planning a convening of experts to discuss the future of methods reporting. Part of that discussion will include how to get publishers to voluntarily adopt a common standard for the minimum information included in a methods section.

About the Authors



David Crotty, Ph.D. is a Senior Consultant at Clarke & Esposito, a boutique management-consulting firm focused on strategic issues related to professional and academic publishing and information services. David was previously the Editorial Director of Journals Policy for Oxford University Press (OUP). In this role, he oversaw journal policy across OUP's journals program, drove technological innovation, and served as an information officer. He also acquired and managed a suite of research-society-owned journals with OUP. Prior to joining OUP, David was the Executive Editor for Cold Spring Harbor Laboratory Press, where he created and edited new science books and journals along with serving as a journal Editor-in-Chief. David has served on the Board of Directors for the STM Association, the Society for Scholarly Publishing and CHOR, Inc., and The AAP-PSP Executive Council. David received his Ph.D. in Genetics from Columbia University and researched developmental neuroscience at Caltech before moving from the bench to publishing. As the Executive Editor of the *Scholarly Kitchen* blog, David regularly writes about current issues in publishing.



Michael Stebbins, Ph.D. is a geneticist and public-policy expert who served as the Assistant Director for Biotechnology in the Obama White House Office of Science and Technology Policy. He is currently the President of Science Advisors, a science and health consulting firm he founded in 2018 to provide science, technology, and public-policy guidance to private companies, philanthropies, and nonprofit organizations. While at the White House, Dr. Stebbins' work led to large initiatives across the federal government to address antibiotic resistance, protect pollinators, improve veterans' mental health, increase access to federally funded scientific research publications and data, promote preferential purchasing of antibiotic-free meats, reform the regulatory system for biotechnology products, drive federal purchasing of bio-based products, and improve management of scientific collections. Dr. Stebbins previously served as the Vice President of Science and Technology for the Laura and John Arnold Foundation, science advisor to the Obama Presidential Campaign, and on the Obama White House Transition Team. He is the former director of biology policy for the Federation of American Scientists and worked for U.S. Senator Harry Reid and at the National Human Genome Research Institute. Before

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